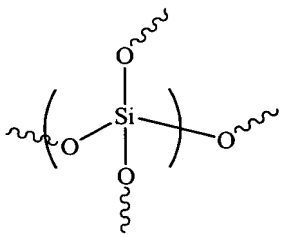
CLAIMS:

1. A functionalized zeolite composition comprising structural units of the formulae:



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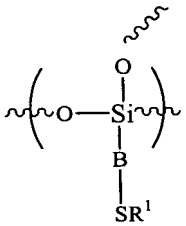

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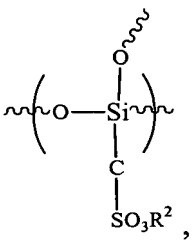

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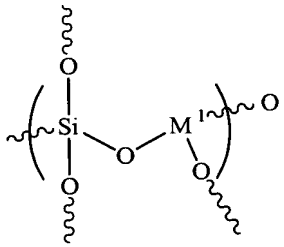
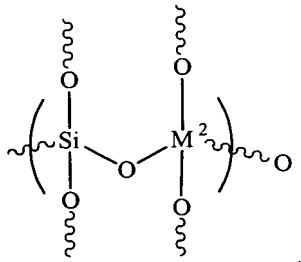
wherein "B" and "C" are spacer groups comprising C_2 to C_{20} hydrocarbyl groups, and R^1 and R^2 independently comprise an alkali metal, a hydrogen, or a C_1 to C_{20} alkyl group.

2. The functionalized zeolite composition of Claim 1, further comprising a structural unit having a formula:



and/or


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wherein M^1 comprises a Group III element selected from the group consisting of boron, aluminum, gallium, or combinations of the foregoing Group III elements; and M^2 comprises a Group IV element selected from titanium, zirconium, or combinations of the foregoing Group IV elements.

3. The functionalized zeolite composition of Claim 2, wherein the formula has a mole ratio of Si to M^1 and/or Si to M^2 greater than or equal to about 10.

4. The functionalized zeolite composition of Claim 1, comprising a microporous zeolite structure having a pore size of about 3 to about 14 angstroms or a

mesoporous zeolite structure having a pore size of greater than or equal to about 14 to about 100 angstroms.

5. The functionalized zeolite composition of Claim 1, wherein the structural units form a microporous zeolite structure comprising mordenite, ZSM-5, L-zeolite, faujasite, ferrierite, chabazite type zeolites or mixtures comprising at least one of the foregoing zeolite structures.

6. The functionalized zeolite composition of Claim 1, wherein the structural units form a mesoporous zeolite structure comprising MCM-41, SBA-15, or mixtures comprising at least one of the foregoing zeolites.

7. The functionalized zeolite composition of Claim 1, wherein the functionalized zeolite composition comprises a surface area of about 100 to about 1,200 square meters per gram of said zeolite composition.

8. The functionalized zeolite composition of Claim 1, further comprising structural units derived from a heteropolyacid compound of the formula: $(M^3)_3(M^4)(M^5)_{12}O_{40}$, wherein M^3 comprises hydrogen or an alkali metal, M^4 comprises phosphorus or silicon, and M^5 comprises tungsten or molybdenum.

9. The functionalized zeolite composition of Claim 1, further comprising structural units derived from a heteropolyacid compound comprising silicotungstic acid, silicomolybdic acid, phosphotungstic acid, phosphomolybdic acid, or combinations comprising at least one of the foregoing heteropolyacids.

10. A method of making a functionalized zeolite composition, comprising:

reacting:

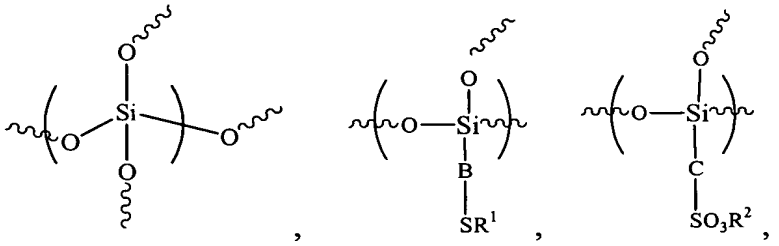
at least one reactant selected from the group consisting of a fumed silica and an alkyl metalate comprising a tetraalkyl orthosilicate,

a mercapto-functionalized alkoxysilane,

a silyl sulfonic acid compound, and

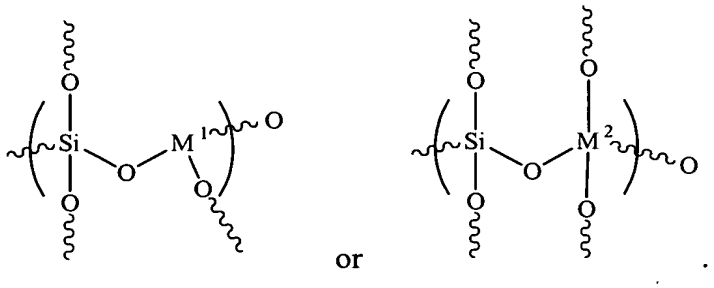
a template compound; and

producing a zeolite composition comprising structural units of the formulae:



wherein "B" and "C" are spacer groups comprising C_2 to C_{20} hydrocarbyl groups; and R^1 and R^2 independently comprise an alkali metal, a hydrogen, or a C_1 to C_{20} alkyl group.

11. The method of Claim 10, wherein the alkyl metalate further comprises at least one compound selected from the group consisting of $(R^4O)_3M^1$ and $(R^4O)_4M^2$; wherein R^4 is independently at each occurrence an alkyl group or an aryl group having from 1 to about 20 carbon atoms; "M^1" comprises a Group III element selected from the group consisting of boron, aluminum, gallium, or combinations of the foregoing Group III elements; and "M^2" comprises a Group IV element selected from the group consisting of titanium, zirconium, or combinations of the foregoing Group IV element, to produce the functionalized zeolite composition further comprising structural units of the formulae:



12. The method of Claim 10, wherein the template compound comprises a quaternary ammonium salt.

13. The method of Claim 10, wherein said tetraalkyl orthosilicate is of the formula $(R^3O)_4Si$, wherein R^3 is an alkyl group.

14. The method of Claim 10, wherein said mercapto-functionalized alkoxysilane is at least one selected from the group represented by the formula $R^1S\text{-}B\text{-}Si(OR^5)_n(R^6)_{3-n}$; wherein "n" is an integer having values from 1 to about 3; R^5 comprises hydrogen and alkyl groups; and R^6 comprises alkyl groups or alkoxy groups.

15. The method of Claim 10, wherein said silyl sulfonic acid compound is of the formula:

$$R^2O_3S\text{-}C\text{-}Si(OR^7)_n(R^8)_{3-n},$$

wherein "n" is an integer from 1 to 3; R^7 comprises hydrogen and alkyl groups; and R^8 comprises alkyl groups or alkoxy groups.

16. The method of Claim 10, wherein said silyl sulfonic acid compound comprises 3-(trimethoxylsilyl)propanesulfonic acid.

17. The method of Claim 11, wherein reacting the at least one reactant with said alkyl metalate comprises a weight ratio of the at least one reactant to the alkyl metalate of about 1 : 1 to about 100 : 1.

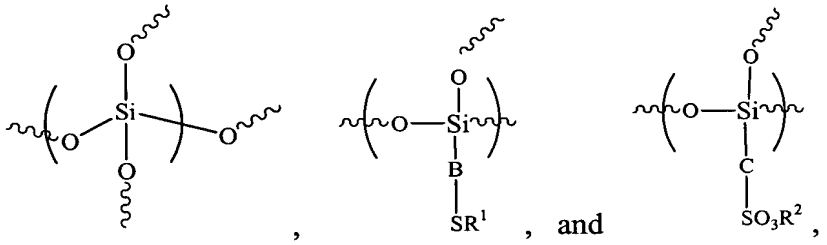
18. The method of Claim 11, wherein said alkyl metalate is at least one compound selected from the group consisting of tetraethyl orthotitanate, tetramethyl orthotitanate, tetraisopropyl orthotitanate, trimethyl aluminate, triethyl aluminate, tri(n-propyl)aluminate, tri(isopropyl)aluminate, tri(n-butyl)aluminate, tri(sec-butyl)aluminate, tri(tert-butyl_aluminate, tetramethyl zirconate, tetraethyl zirconate, tetrapropyl zirconate, and tetraphenyl zirconate.

19. A method of making a functionalized zeolite composition, wherein said method comprises:

reacting a template compound, at least one first reactant selected from the group consisting of fumed silica and an alkyl metalate comprising a tetraalkylorthosilicate, and a first mercapto-functionalized alkoxysilane to form a first intermediate product;

oxidizing said first intermediate product with an oxidizing agent to form a second intermediate product; and

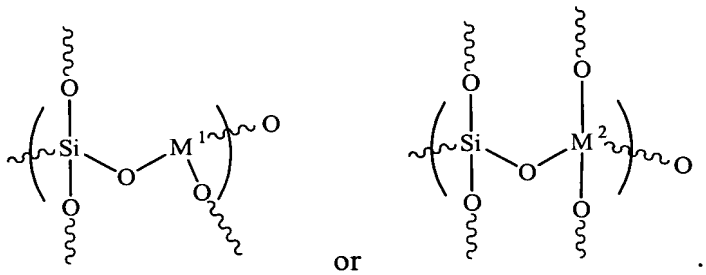
reacting second intermediate product with a second mercapto-functionalized alkoxysilane to produce a functionalized zeolite composition comprising structural units of the formulae:



, , and ,

wherein "B" and "C" are spacer groups comprising $C_2 - C_{20}$ hydrocarbyl groups; and R^1 and R^2 independently of each other comprise alkali metal, hydrogen, or alkyl groups.

20. The method of Claim 19, wherein the alkyl metalate further comprises at least one compound selected from the group consisting of $(R^4O)_3M^1$ and $(R^4O)_4M^2$; wherein R^4 is independently at each occurrence an alkyl group or an aryl group having from 1 to about 20 carbon atoms; "M^1" comprises a Group III element selected from the group consisting of boron, aluminum, gallium, or combinations of the foregoing Group III elements; and "M^2" comprises a Group IV element selected from the group consisting of titanium, zirconium, or combinations of the foregoing Group IV element, to produce the functionalized zeolite composition further comprising structural units of the formulae:



or .

21. The method of Claim 19, wherein said template compound comprises a quaternary ammonium salt.

22. The method of Claim 19, wherein said alkyl metalate is of the formula: $(R^3O)_4Si$; wherein R^3 comprises an alkyl group.

23. The method of Claim 20, wherein said alkyl metalate is at least one selected from the consisting of tetraethyl orthotitanate, tetramethyl orthotitanate, tetraisopropyl orthotitanate, trimethyl aluminate, triethyl aluminate, tri(n-propyl)aluminate, tri(isopropyl)aluminate, tri(n-butyl)aluminate, tri(sec-butyl)aluminate, tri(tert-butylaluminate, tetramethyl zirconate, tetraethyl zirconate, tetrapropyl zirconate, and mixtures of the foregoing alkyl metalates.

24. The method of Claim 19, wherein said first mercapto-functionalized alkoxysilane and said second mercapto-functionalized alkoxysilane are independently selected from the group represented by the formula, $R^1S\text{-}B\text{-}Si(OR^5)_n(R^6)_{3-n}$, wherein "n" is an integer having values from 1 to about 3; R^5 comprises hydrogen or alkyl groups, and R^6 comprises alkyl groups.

25. The method of Claim 19, wherein said oxidizing agent comprises hydrogen peroxide, an aliphatic peracid, or an aromatic peracid.

26. The method of Claim 19, wherein said tetraalkyl orthosilicate and said first mercapto-functionalized alkoxysilane are present in a weight ratio from about 98 : 2 to about 60 : 40.

27. The method of Claim 19, wherein said tetraalkyl orthosilicate and said second mercapto-functionalized alkoxysilane are present in a weight ratio from about 98 : 2 to about 60 : 40.

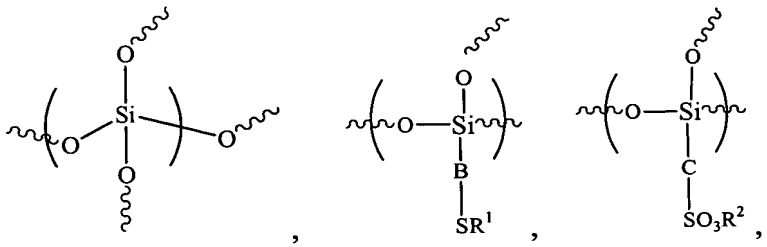
28. A method of making a heteropolyacid-functionalized zeolite composition, said method comprising:

reacting in a solvent a template compound, at least one first reactant selected from the group consisting of fumed silica and an alkyl metalate comprising a tetraalkylorthosilicate, and a first mercapto-functionalized alkoxysilane to form a first intermediate product;

oxidizing said first intermediate product with an oxidizing agent to form a second intermediate product; and

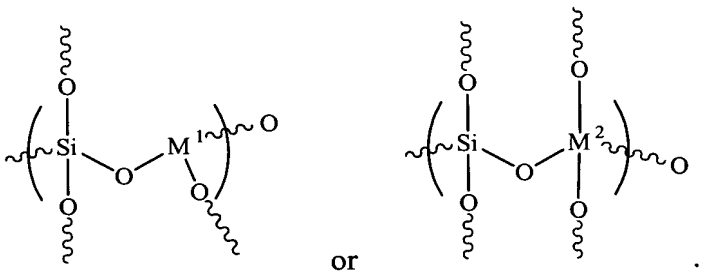
reacting the second intermediate product with a second mercapto-functionalized alkoxysilane to form a third intermediate product; and

reacting said third intermediate product with a heteropolyacid compound to produce the heteropolyacid-functionalized zeolite composition comprising structural units of the formulae:



wherein "B" and "C" are spacer groups comprising $C_2 - C_{20}$ hydrocarbyl groups; and R^1 and R^2 independently of each other comprise alkali metal, hydrogen, or alkyl groups.

29. The method of Claim 28, wherein the alkyl metalate further comprises at least one compound selected from the group consisting of $(R^4O)_3M^1$ and $(R^4O)_4M^2$; wherein R^4 is independently at each occurrence an alkyl group or an aryl group having from 1 to about 20 carbon atoms; "M^1" comprises a Group III element selected from the group consisting of boron, aluminum, gallium, or combinations of the foregoing Group III elements; and "M^2" comprises a Group IV element selected from the group consisting of titanium, zirconium, or combinations of the foregoing Group IV element, to produce the functionalized zeolite composition further comprising structural units of the formulae:



30. The method of Claim 28, wherein said template compound comprises a quaternary ammonium salt.

31. The method of Claim 28, wherein the fumed silica and the alkyl metalate are present at a mole ratio of about 1 : 1 to about 100 : 1.

32. The method of claim 28, wherein the heteropolyacid and the third intermediate product are present at a mole ratio of 2 : 98 to about 40 : 60.

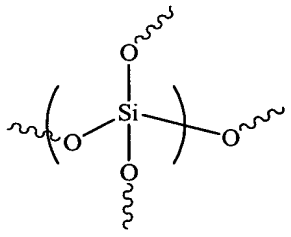
33. The method of claim 28, wherein the second intermediate product and the second mercapto-functionalized alkoxysilane are present at a mole ratio of about 0.25 : 1 to about 4 : 1.

34. The method of Claim 28, wherein said first mercapto-functionalized alkoxysilane and said second mercapto-functionalized alkoxysilane are independently selected from the group represented by the formula, $R^1S\text{-}B\text{-}Si(OR^5)_n(R^6)_{3-n}$; wherein "n" is an integer having values from 1 to about 3; R^5 comprises hydrogen or alkyl groups; and R^6 comprises alkyl groups or alkoxy groups.

35. The method of Claim 28, wherein said oxidizing agent comprises hydrogen peroxide, an aliphatic peracid, or an aromatic peracid.

36. The method of Claim 28, wherein said heteropolyacid compound is of the formula: $(M^3)_3(M^4)(M^5)_{12}O_{40}$; wherein M^3 comprises hydrogen or an alkali metal; M^4 comprises phosphorus or silicon, and M^5 comprises tungsten or molybdenum.

37. A method of producing an aromatic bisphenol, wherein said method comprises reacting a carbonyl compound with an aromatic hydroxy compound in the presence of a functionalized zeolite composition as catalyst; wherein said functionalized zeolite composition comprises structural units of the formulae:



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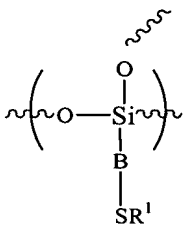

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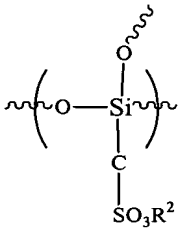

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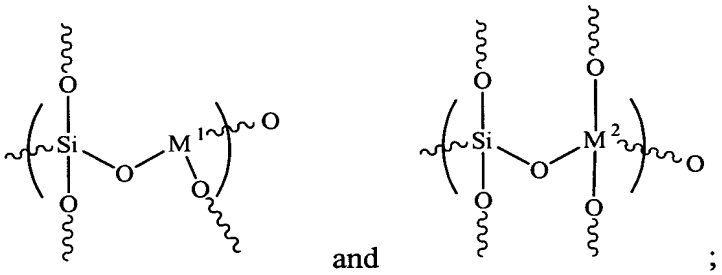
wherein "B" and "C" are spacer groups comprising C_2 to C_{20} hydrocarbyl groups; and R^1 and R^2 independently comprise an alkali metal, a hydrogen, or an alkyl group.

38. The method of Claim 37, wherein the functionalized zeolite composition further comprises structural units selected from the group consisting of formulae:



and ;

wherein M^1 comprises a Group III element, and M^2 comprises titanium or zirconium.

39. The method of Claim 37, wherein said carbonyl compound is at least one selected from the group consisting of acetone, methyl ethyl ketone, diethyl ketone, benzyl, acetyl acetone, methyl isopropyl ketone, methyl isobutyl ketone, acetophenone, ethyl phenyl ketone, cyclohexanone, cyclopentanone, benzophenone, fluorenone, indanone, anthraquinone, 4-hydroxyacetophenone, 4,4'-dihydroxybenzophenone, acenaphthenequinone, quinone, benzoylacetone diacetyl, fluorenone, bicyclo[2.2.1]heptan-2-one, and 3,3,5-trimethylcyclohexanone.

40. The method of Claim 37, wherein said aromatic hydroxy compound is at least one selected from the group consisting of phenol, 2-cresol, 3-cresol, 4-cresol, 2-chlorophenol, 3-chlorophenol, 4-chlorophenol, 2-tert-butylphenol, 2,4-dimethylphenol, 2-ethyl-6-methylphenol, 2-bromophenol, 2-fluorophenol, 2-phenoxyphenol, 3-methoxyphenol, 2,3,6-trimethylphenol, 2,3,5,6-tetramethylphenol, 2,6- xylenol, 2,6-dichlorophenol, 3,5-diethylphenol, 2-benzylphenol, 2,6-di- tert-butylphenol, 2-phenylphenol, 1-naphthol, and 2-naphthol.

41. The method of Claim 37, wherein said zeolite composition further comprises structural units derived from a heteropolyacid compound of the formula: $(M^3)_3(M^4)(M^5)_{12}O_{40}$, wherein M^3 comprises hydrogen or an alkali metal; M^4 comprises phosphorus or silicon, and M^5 comprises tungsten or molybdenum.

42. The zeolite composition of Claim 41, wherein said heteropolyacid compound comprises at least one heteropolyacid selected from the group consisting of silicotungstic acid, silicomolybdic acid, phosphotungstic acid, and phosphomolybdic acid.

43. The method of Claim 37, wherein said carbonyl compound and said aromatic hydroxy compound are reacted in a batch or a continuous process.

44. The method of Claim 37, wherein said functionalized zeolite composition comprises microporous zeolites and mesoporous zeolites.

45. A method of producing a polycarbonate from the aromatic bisphenol prepared in accordance with the method of Claim 37.

46. The method of Claim 45, wherein said aromatic bisphenol comprises bisphenol A.